Thin film optical axis gratings by photo-alignment and spin-coating of liquid crystal

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Optical axis gratings allow diffracting light in one order with high efficiency, as illustrated in Figure 1(a). Layer-by-layer spin-coating of polymerizable LC and curing can provide a thin film with different thicknesses [1]. The sample with thickness 2.63µm in Fig. 1(b) has useful retardation. Photo-alignment with two circularly polarized UV laser beams defines the alignment for the optical axis grating. The thickness was tuned from 0.5um to 4 um. The diffraction angle of the first order was varied between 4.0° and 6.8°. The polarization grating between crossed polarizers is shown in figure 1(c). By analyzing the images shown in Fig. 1(d) we could estimate the imperfections in the illumination procedure.

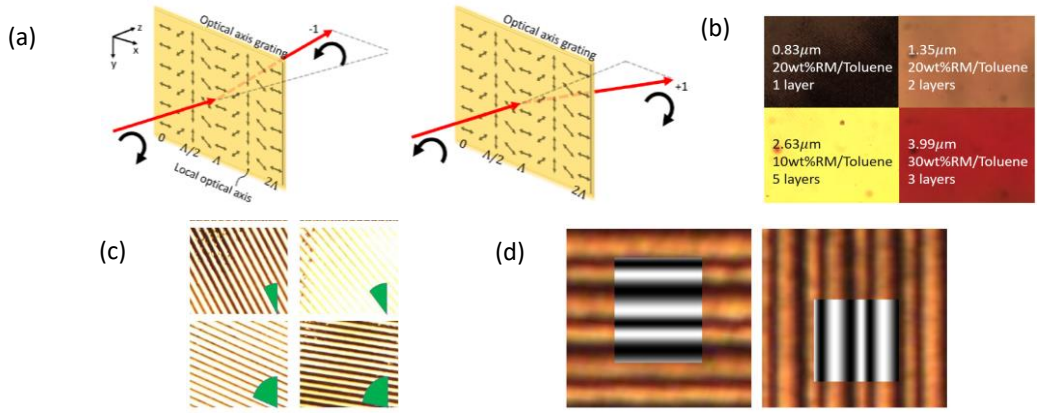

Figure 1: (a) Diffraction for a 1D optical axis grating. (b) Microscopy images for cells with different thicknesses, depending on the liquid crystal/toluene ratio and the number of spin coated layers. (c) Microscopy images of 1D polarization gratings. The fan in the lower right corner indicates the angle of rotation (c) (d) Microscope images and numerical simulation of the transmission (black and white part).

Results from numerical simulations can predict the optical characteristics of the gratings accurately. The simulations can also predict the properties of the grating taking into account inaccuracies that may occur during the fabrication process.

[1] K. Gao, H. Cheng, A. K. Bhowmik, and P. J. Bos, Thin-film Pancharatnam lens with low f-number and high quality. Optics Express, 2015. 23(20): p. 26086-26094.